

CLAIMS

WE CLAIM:

1. A cathode assembly for a metal-air cell including an air diffusion layer receiving air and delivering the received air to the cathode assembly, the cathode assembly comprising:
an active layer including longitudinally extending electrically conducting wires interwoven with laterally extending electrically conducting wires that intersect at joints to form a mesh, and metal deposited onto the wires that bonds the longitudinally extending wires to the laterally extending wires at the joints to form a screen.
2. The cathode assembly as recited in claim 1, wherein the metal comprises nickel.
3. The cathode assembly as recited in claim 2, wherein the nickel is electroplated onto the wires.
4. The cathode assembly recited in claim 3 wherein the nickel is deposited by one of electroless deposition, sputter deposition, and chemical deposition.
5. The cathode assembly as recited in claim 2, wherein the nickel forms nodules that protrude outwardly from an outer surface of the wires.
6. The cathode assembly as recited in claim 5, wherein the outer surface deposit comprises columnar grains.
7. The cathode assembly as recited in claim 6, further comprising nodules extending from the surface wherein the nodules are between 10 to 100 μm in diameter.
8. The cathode assembly as recited in claim 5, wherein the outer surface and nodules further comprise grains having diameters between 1 and 30 μm .
9. The cathode assembly as recited in claim 5, wherein the nodules occupy between 5 and 50 percent of a surface area of the nickel.
10. The cathode assembly as recited in claim 1, wherein the wires comprise nickel.
11. The cathode assembly as recited in claim 1, wherein the wires comprise a transition metal.

12. The cathode assembly as recited in claim 1, further comprising a mixture of carbon and PTFE disposed on an outer surface of the screen.
13. A metal-air cell comprising:
 - a void that is filled with active anode material;
 - a cathode assembly receiving ambient cathodic air, including:
 - i. an active carbon catalyst; and
 - ii. a screen in contact with the catalyst, wherein the screen includes longitudinally extending electrically conducting wires interwoven with laterally extending electrically conducting wires that intersect at joints, and wherein the metal is bonded to the wires at the joints; and
 - a separator disposed between the cathode assembly and the anode material.
14. The metal-air cell recited in claim 13, wherein the metal comprises nickel.
15. The metal-air cell recited in claim 14, wherein the nickel is electroplated onto the wires.
16. The cathode assembly as recited in claim 5, wherein the outer surface deposit comprises columnar grains.
17. The metal-air cell recited in claim 16, wherein a plurality of nodules extends outwardly from the surface.
18. The metal-air cell as recited in claim 17, wherein the nodules are between 10 and 100 μm in diameter.
19. The metal-air cell as recited in claim 17, wherein the surface and nodules further comprise grains having diameters between 1 and 30 μm .
20. The metal-air cell as recited in claim 17, wherein the nodules occupy between 5 and 50 percent of a surface area of the nickel.
21. The metal-air cell as recited in claim 13, wherein the wires comprise nickel.
22. The metal-air cell as recited in claim 13, wherein the wires comprise a transition metal.

23. The metal-air cell as recited in claim 13, wherein the catalyst further comprises a mixture of carbon and PTFE in contact with the screen.
24. The metal-air cell as recited in claim 13, further comprising a button cell.
25. The metal-air cell as recited in claim 24, further comprising a cathode can surrounding the cathode assembly and defining air ports extending therethrough.
26. The metal-air cell as recited in claim 25, further comprising at least one air diffusion layer disposed between the cathode can and the screen.
27. The metal-air cell as recited in claim 13, further comprising a cylindrical cell.
28. The metal-air cell as recited in claim 27, wherein the screen is disposed between the separator and the carbon catalyst.
29. The metal-air cell as recited in claim 28, wherein the carbon catalyst is disposed between the separator and the screen.
30. A method for fabricating a cathode assembly for use in a metal air cell of the type having an air diffusion layer receiving air and delivering the received air to the cathode assembly, the steps comprising:
- (a) providing a mesh having longitudinally extending wires interwoven with laterally extending wires, wherein the wires intersect at joints;
 - (b) providing an electroplating apparatus including a current source electrically connected to the mesh at one terminal and a mass of metal at another terminal;
 - (c) immersing the mesh and mass in a salt of the metal to electroplate the wires with the metal at the joints, wherein the electroplated metal bonds the joints together to provide a cathode screen; and
 - (d) coating the cathode screen with an active cathode catalyst.
31. The method as recited in claim 30, wherein the metal comprises nickel.
32. The method as recited in claim 31, wherein step (c) further produces nodules protruding from outer surfaces of the wires.
33. The method as recited in claim 32, wherein the outer surface grains are columnar.

34. The method as recited in claim 30, wherein the metal salt is selected from the group consisting of nickel chloride, nickel sulfate, nickel sulfamate, and nickel fluoborate.
35. The method as recited in claim 30, wherein the wires comprise nickel.
36. The method as recited in claim 30, wherein the wires comprise a transition metal.
37. The method as recited in claim 30, wherein the active cathode catalyst comprises a mixture of PTFE and carbon.
38. The method as recited in claim 30, further comprising pressure bonding the mesh.
39. A method for producing a metal-air cell, the steps comprising:
- (a) providing an anode can defining a void that is filled with active anode material;
 - (b) providing a cathode can surrounding a portion of the anode can, wherein the cathode can defines air ports extending therethrough;
 - (c) installing an air diffusing layer into the cathode can;
 - (d) installing a cathode assembly positioned downstream of the air diffusing layer, the cathode assembly, including:
 - i. an active carbon catalyst; and
 - ii. a screen in contact with the catalyst, wherein the screen includes longitudinally extending electrically conducting wires interwoven with laterally extending electrically conducting wires that intersect at joints, and wherein the metal is bonded to the wires at the joints; and
 - (e) installing a separator between the cathode assembly and the anode.
40. The method as recited in claim 39, further comprising electroplating the metal onto the wires.
41. The method as recited in claim 40, wherein the metal comprises nickel.
42. The method as recited in claim 39, wherein the active carbon catalyst comprises a mixture of carbon and PTFE.
43. The method as recited in claim 39, wherein the wires comprise nickel.

44. The method as recited in claim 39, wherein the wires comprise a transition metal.
45. A method for producing a cylindrical metal-air cell, the steps comprising:
- (a) providing a screen having longitudinally extending electrically conducting wires interwoven with laterally extending electrically conducting wires that intersect at joints, and wherein the metal is bonded to the wires at the joints; and
 - (b) coating the screen with an active carbon catalyst to provide a cathode assembly, wherein the catalyst is positioned to receive ambient air;
 - (c) winding the cathode assembly into an annulus defining an internal anode void;
 - (d) installing a separator between the cathode assembly and the void; and
 - (e) providing an anode material in the void.
46. The method as recited in claim 45, further comprising electroplating the metal onto the wires.
47. The method as recited in claim 45, wherein the metal comprises nickel.
48. The method as recited in claim 45, wherein the active carbon catalyst comprises a mixture of carbon and PTFE.
49. The method as recited in claim 45, wherein the wires comprise nickel.
50. The method as recited in claim 45, wherein the wires comprise a transition metal.
51. The method as recited in claim 45, further comprising coating the active carbon catalyst on an outer surface of the screen.
52. The method as recited in claim 45, further comprising coating the active carbon catalyst on an inner surface of the screen.
53. A method for fabricating an electrochemical cell, comprising:
- (a) providing a mesh having longitudinally extending wires interwoven with laterally extending wires, wherein the wires intersect at joints;
 - (b) pressure-bonding one surface of the mesh to partially bond the wires together at the joints;

(c) providing an electroplating apparatus including a current source electrically connected to the partially bonded mesh at one terminal and a mass of nickel at another terminal;

(d) immersing the partially bonded mesh and mass in a nickel salt to electroplate the wires with nickel at the joints, wherein the electroplated nickel fully bonds the joints together to form a screen;

(e) coating the screen with an active catalyst layer to form a cathode assembly;

(f) providing a void filled with an anode material; and

(g) installing a separator between the cathode assembly and the anode material.

54. The method as recited in claim 53, wherein step (d) further produces nodules protruding from outer surfaces of the wires.

55. The method as recited in claim 54, wherein the outer surface grains are columnar.

56. The method as recited in claim 53, wherein the metal salt is selected from the group consisting of nickel chloride, nickel sulfate, nickel sulfamate, and nickel fluoborate.

57. The method as recited in claim 53, wherein the wires comprise nickel.

58. The method as recited in claim 53, wherein the wires comprise a transition metal.

59. The method as recited in claim 53, wherein the catalyst comprises a mixture of PTFE and carbon.

60. A method for fabricating an electrochemical cell disposed in a container, the steps comprising:

(a) providing a mesh having longitudinally extending wires interwoven with laterally extending wires intersecting at joints;

(b) plating a metal onto the wires to bond the joints together;

(c) coating the screen with an active catalyst layer to form a cathode assembly;

(d) providing a void filled with an anode material;

(e) installing a separator between the cathode assembly and the anode material;

and

(f) closing the container, thereby compressing the cathode assembly against the container to form a seal preventing electrolyte leakage from the cell.

61. The method as recited in claim 60, wherein step (b) further comprises:

- i. providing an electroplating apparatus including a current source electrically connected to the mesh at one terminal and a mass of metal at another terminal; and
- ii. immersing the partially bonded mesh and mass in a salt to electroplate the wires with the metal at the joints, wherein the electroplated metal fully bonds the joints together to form a screen.

62. The method as recited in claim 61, wherein the metal comprises nickel.

63. A method for producing a metal-air cell, the steps comprising:

- (a) providing an anode can defining a void that is filled with active anode material;
- (b) providing a cathode can surrounding a portion of the anode can, wherein the cathode can defines air ports extending therethrough;
- (c) installing a cathode assembly positioned downstream of the air diffusing layer, the cathode assembly, including:
 - i. an active carbon catalyst;
 - ii. a screen in contact with the catalyst, wherein the screen includes longitudinally extending electrically conducting wires interwoven with laterally extending electrically conducting wires that intersect at joints, and wherein the metal is bonded to the wires at the joints; and
 - iii. a diffusion layer coated onto the active carbon catalyst; and
- (d) installing a separator between the cathode assembly and the anode.